Duke Energy Morro Bay, LLC

Updated Analysis of Alternative Cooling Systems For the Morro Bay Modernization Project

January 7, 2002

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1 Overview

This paper summarizes Duke Energy Morro Bay, LLC (Duke's) best available information concerning the costs, environmental impacts, and other constraints of two possible alternatives to the proposed project's seawater cooling system. It is Duke's opinion that even if any such alternative could be constructed (an open question) it would be less protective of the environment than Duke's proposed project.

To carry out this analysis, Duke built upon the original analysis and changed assumptions and methodology as appropriate to account for Duke's evolving understanding of various attributes of each alternative. Duke's estimates of economic costs have been derived by contractors and vendors using their best engineering judgments rather than from detailed drawings and plans. Accordingly, the magnitude of these costs is most likely understated.

To summarize the key attributes of both alternatives:

1. Neither the air-cooled nor hybrid alternative could be constructed within the footprint constraint of Duke's current site.

2. Neither the air-cooled nor hybrid alternative would comply with several ordinances and regulations (LORS) with respect to negative visual impacts of new structures on the coast of California.

3. Neither the air-cooled nor hybrid alternative is consistent with the strongly expressed desires of the community with respect to the visual impacts of the project.

4. When compared to Duke's proposed project, both alternatives would have negative visual and noise impacts.

5. It is not clear that it is even feasible to construct either alternative, given the site constraints and required earthquake standards. Were these limitations to be fully analyzed, project costs would be expected to be significantly higher.

6. While the estimated costs of both alternatives is considerably less than in our previous analysis, even the reduced incremental costs of the alternatives ($106-$114 million on a Net Present Value basis) are wholly disproportionate to relatively modest marine biology benefits from reduced use of seawater cooling.

7. Hybrid cooling represents the worst of both worlds: Increased complexity over air-cooled condensers means lower reliability for about the same cost, and it is premised on availability of make-up water that is far from certain.

2 Introduction

This document provides a current and consolidated review of Duke Energy Morro Bay, LLC's (Duke) analysis of possible alternative cooling options for the proposed Morro Bay Power Plant (MBPP) Project. The two systems evaluated are1) air cooled condensers (ACC) and 2) hybrid wet/dry cooling systems (Hybrid) that includes air coolers combined with mechanical draft cooling towers utilizing fresh water sources.

This analysis is the culmination of work that has been ongoing since the issuance of the AFC in October of 2000. There have been four distinct efforts by Duke[1]:

- Conceptual evaluations contained in the AFC (October, 2000)
- Previous analyses contained in the 316(b) Report (May 11, 2000)
- Materials presented at the July 12, 2000 meeting of the Regional Water Board. This analysis was supplemented with an environmental review including some Key Observation Points (KOPs) in an August 9, 2001 brief presented initially at the City of Morro Bay council meeting and later docketed with the CEC
- This updated analysis.

This paper recaps: 1) the previous economic analysis and rationale behind the approach to sizing alternative cooling systems, 2) the steps Duke has taken to define and establish a more representative physical design, and 3) the environmental and economic impacts for both the Air Cooling Condensers (ACC) and the "Hybrid" wet/dry systems for the current design concepts. Appendix A contains a matrix comparing the key assumptions in both the previous and current analyses and explains why Duke believes the changes in the assumptions and methodology for this updated analysis are appropriate.

3 Re-cap of Alternate Air Cooling Analysis

The MBPP modernization project proposes to use once-through seawater cooling; the same cooling system used in the existing plant. In accordance with CEQA guidelines, Duke specified once-through seawater cooling for both the baseline and proposed project. When agencies requested an evaluation of alternative cooling systems, Duke conducted the analysis within the parameters outlined in the CEQA guidelines: alternatives were evaluated at a conceptual level as opposed to the more detailed analysis required for the base case.[2] Therefore, the evaluation of

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[1] The evolution of the paramaters for performance simulations for the proposed project are shown in Appendix C, along with a historical record of other documents relating to Duke's analysis of alternative cooling systems.

[2] "(d) Evaluation of alternatives. The EIR shall include sufficient information about each alternative to allow meaningful evaluation, analysis, and comparison with the proposed project. A matrix displaying the major characteristics and significant environmental effects of each alternative may be used to summarize the comparison. If an alternative would cause one or more significant effects in addition to those that would be caused by the project

possible cooling system alternatives was based solely on a rough sizing of equipment and limited consideration of operational constraints. This analysis, per the requirements of CEQA, did not include the same level of engineering detail as that for the base case presented in the AFC. Duke believes the original conceptual level of detail was sufficient to compare the relative environmental and economic impacts of possible alternatives.

In brief, key conclusions of the earlier analysis were[3]:

- The economic impact of the alternatives were evaluated on an incremental Present Value (PV) and annual cost basis. The Present Value encompassed the capital cost of the alternative, the annual O&M costs, and the value of reduced plant efficiency expressed as the capital and energy costs of a hypothetical "make-up" plant.

- For the ACC system the incremental PV costs were estimated to be $301 million, equivalent to $24 million on an annualized basis.

- For the Hybrid alternative the incremental PV costs were estimated to be $273 million, equivalent to $22 million on an annualized basis.

- Duke concluded that the economic impact was disproportionate to the environmental benefits

- Various noise, visual, and land use impacts were assessed and determined to be negative.

- The size of the system, combined with the site constraints at the Morro Bay Power Plant, would present substantial constructability problems for both alternatives.

The report was presented to the CEC, RWQCB, and other stakeholders on August 9, 2001. During the past several months, these agencies have asked additional questions about Duke's assumptions concerning the size of the units, noise from the units, constructability issues, estimated efficiency (power) losses, and total economic costs.

To help the agencies and other stakeholders better understand Duke's thinking and analysis of the cooling alternatives, eliminate conflicting information on this matter, and update Duke's analysis based on the currently best available data, Duke has prepared the analysis below.

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as proposed, the significant effects of the alternative shall be discussed, but in less detail than the significant effects of the project as proposed. (County of Inyo v. City of Los Angeles (1981) 124 Cal.App.3d 1)." Guidelines section 15126.6(d)

[3] See:

a. Economic Analysis of Cooling Water Alternatives that Duke submitted to RWQCB and CEC on June 29 and July 2, 2001 respectively.

b. "Evaluation of Alternative Intake Technologies – Air-Cooled Condensers" Report, dated August 9, 2001, delivered to the City of Morro Bay on with copies sent to CEC, RWQCB, and CCC for more details. A summation of the previous analysis is provided in Appendix B of this document.

Note: We received the Tetra Tech alternative cooling report (dated December 26, 2001) prepared for the California Regional Water Quality Control Board (Central Coast Region) just prior to publishing this report. We have done a cursory evaluation of their work and have drawn some preliminary conclusions. While Tetra Tech makes several good points in a number of areas, we do not agree or accept their alternative cooling costs or the technical data upon which they are based. The systems presented appear more representative of generic designs, and therefore do not reflect the specific requirements of the Morro Bay site. The report's conclusions significantly underestimate the system sizing and costs necessary for alternative cooling systems at the Morro Bay site. Duke will provide additional information after we have more fully evaluated the report.

4 Updated Cooling Options Analysis

To better understand the environmental and economic impacts of using alternative cooling for the proposed MBPP Project, Duke conducted additional evaluations of the cooling water alternatives. In the course of the last month, Duke refined the methodology, validated assumptions, corrected some deficiencies in previous data, and identified and verified probable environmental impacts.

Revisiting the assumptions used in previous work allowed a more in-depth design and development effort. This, in turn, led to a resizing of equipment to satisfy operating limits and achieve operating flexibility to allow the plant's target output to be reached across almost the entire ambient temperature range. Key considerations include:

- A design cycle that enables an alternately cooled plant to consistently produce 1200 MW except at the extreme high temperature range. This is a different methodology than the earlier analysis. Upon revisiting the initial design assumptions, Duke allows for variations in the duct firing rate within the current duty cycle as depicted in Appendix L in order to achieve 1200 MW.

- Duke discovered that the air cooled condenser was undersized in the earlier analysis and resulted in a steam turbine back pressure that exceeded the equipment limits at higher ambient temperatures. This occurred as the analysis for sizing the condensers did not consider the full ambient temperature range, but rather focused on a single average temperature. In effect, this is an error that has been corrected in this analysis.

- More accurate equipment size and configuration estimates allows Duke to more realistically represent the required plot space and location for each alternative.

- Consideration of earthquake "Zone 4" criteria in the structural design performance elements.

- Evaluation of the impacts, if any, to stack heights (to meet air emissions standards) and scenic visual corridors due to the height of the coolers with the more specific design elements.

- Research by Duke into 1) if (and how) the cooling towers could be designed to ensure compliance with federal, state, and local noise requirements, and 2) establishing preliminary vendor costs and capabilities necessary to achieve compliance.

For specific details associated with the above items please refer to Appendix A.

4.1 Current Cost and Size Estimates

After Duke completed a more in-depth design cycle, the two primary ACC vendors were contacted to provide budgetary estimates based on the design parameters. The vendors provided preliminary size and configuration, a quote for the capital and erection costs of their equipment, and the lowest noise level achievable at 400 feet from their condensers.

Based on the vendor supplied capital and installation quotes, Duke estimated the installed capital costs shown in Table 1 (a detailed cost buildup is shown in Table 2). Please note that the 316(b) analysis requires that the costs be evaluated on an incremental basis. These costs are incremental over and above the costs otherwise incurred with the proposed once-through sea-water cooling system.

Table 1: Current Installed Capital and Annual O&M Cost Estimates (in millions)

	Capital Cost		Annual O&M	
Alternative	**Absolute**	**Incremental**	**Absolute**	**Incremental**
Once-through cooling (Base Case)	$25	$0	$0.3	$0
Air Cooled Condenser	$80 - $85	$55 - $60	$0.6	$0.3
Hybrid Wet/Dry Cooling	$81 - $86	$56 - $61	$0.8	$0.5

While the vendors responded with slightly different equipment configurations, both vendors required approximately 60,000 square feet of plot space per power block (120,000 square feet total) -- approximately 185 feet x 320 feet for each 600 MW power block for the ACC system. The plot requirement is further complicated by the fact that to avoid significant design issues, a maximum of six fans per bay can be used. The units were placed on the plot plan and kept as close to the steam turbines as possible (125 feet). Even this compact configuration for the minimum footprint required by the air coolers exceeds the amount of land available on the Duke project site. Detailed plot plans are in Appendix D, and site constraints are further explained and visually demonstrated in Appendix E.

Table 2: Detailed Cost Buildup

	Air Cooled Condenser (in millions)	Hybrid Wet/Dry Cooling (in millions)
Equipment	$40.5	$36
Erection	$20	$15
Preparation*, **	$20-25	$15-20
WWTP Upgrades***	N/A	$15
Absolute Capital Cost (rounded to Nearest $5 million)	**$80 – $85**	**$81 - $86**

* Preparation includes pilings, foundations, piping, and duct work to equipment; electrical work; instrumentation; and control.

** These costs DO NOT include undefined complexities such as: constructibility impacts related to spanning the return tunnels, minimization of down time, corresponding impact to ACC structure to span the tunnels, and a number of other potential, but undefined, costs that would evolve during detail design.

*** Due to the scarcity of fresh water supplies and the desire to eliminate the use of seawater as the make-up water for the cooling tower in Hybrid Wet Dry alternative, Duke assumed the make-up water to be provided solely by the effluent discharge of the Morro Bay WWTP (Waste Water Treatment Plant). The water quality discharge currently does not meet the required quality for cooling tower[4] use. At least $15MM would be required to upgrade the WWTP discharge to disinfected tertiary quality[5]; the quality level required for water used in a cooling tower. The required investment is included in the Hybrid Wet/Dry Cooling capital cost. However, the cost to bring a pipe from the WWTP to the MBPP site is not included. It should be noted that it is not certain the WWTP could reliably supply the 1,400 gpm assumed in our analysis. If it can't, then the size of the Air Cooled Condenser in the Hybrid system may have to be increased, increasing the cost and footprint.

In addition to the increased square footage necessary to accommodate the additional equipment, the overall height of the units (ACC) will be 110 feet.[6] The first 65-70 feet of the units are open structure (support columns and bracing); the remaining top 40-45 feet would be a solid mass enclosure covering the condensers. The top of the distribution header would be 110 feet and become the highest structure in the plant, except for the stacks, adding substantial bulk and density to the facility.

Other critical issues arise from locating the unit in an earthquake "Zone 4 plus" area. This location also requires the unit to span the existing seawater return tunnels-- a difficult

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[4] California Health Code, Title 22

[5] Cayucos/Morro Bay Comprehensive Recycled Water Study, Carullo Engineers, March 2000

[6] The earlier KOPs that Duke submitted were incorrectly rendered. They showed the distribution header at approximately 65 feet. This was a computer rendering error. The earlier configuration should have been portrayed as the same 110 feet height.

engineering problem. How to solve this issue has yet to be assessed, but the results would certainly impact cost (equipment and construction) as well as constructability. These potentially significant costs have not been estimated and are NOT reflected in Table 1 above.

4.2 Visual Impacts

4.2.1 Air Cooled Condensers

The visual analysis of cooling alternatives was based on a set of four visual simulations, which are included in Appendix F. A visual simulation uses a digital photograph of existing scenery and overlays a three-dimensional computer model of the equipment as viewed from the same location. The result is a photo-realistic representation of the design alternative as it would appear from a selected KOP:

- KOP 7 Near view from beach, increased public access, condensers visible
- KOP 8 View from west, representative of view from water
- KOP 14 Representative view from neighborhoods on hillside to northeast.
- KOP 15 Residential view, from hillside to east

The visual analysis compares the Project as proposed in the AFC, with the visual change incurred as a result of the addition of cooling equipment. Each KOP simulation was evaluated by a set of four criteria:

- Area occupied by the power plant and the new cooling equipment
- Area penetrating skyline (extending above horizon)
- Horizontal field of view (width of area occupied by the power plant)
- Obstruction of features (Views of the Rock, Ocean, Beach or Distant hills that would otherwise be visible)

The Project, as defined in the AFC, is smaller in height and bulk and occupies less of the coastal site than the ACC alternative. The ACC alternative requires large array of air condensers in an enclosure that in every case, when evaluated against the visual criteria, consistently caused a significant negative visual effects. Specifically, the negative visual effects of adding air cooling equipment to the MBPP include; (1) a significant increase in the total area occupied by the power plant, (2) significant increase in the area penetrating the skyline or obstructing coastal features, and (3) significant increases in the horizontal field of view occupied by the power plant. Each of these findings is inconsistent with the City of Morro Bay's expressed desire to minimize the height and bulk of the facility. It is Duke's belief that the size of these condensers would not be acceptable to the larger community in Morro Bay. Please see discussion below in Section 4.7 regarding Morro Bay Community Concerns.

4.2.2 Hybrid Wet/Dry Cooling System

The Hybrid alternative would have similar impacts as the air-cooled condensers. However, the wet cooling towers associated with the hybrid system also tend to generate visible water vapor plumes. As the wet cooling towers would be operated on a continuous basis, the frequency with which these plumes would be generated will probably be greater than the frequency predicted for the HRSG plumes associated with the proposed project. The plumes from the towers would also be much larger, across the entire surface area of the tower.

See Appendix F for the KOPs and a complete review of the visual implications.

4.3 Noise Impacts

This section summarizes an additional noise impact assessment conducted for the two alternative systems. Since these two cooling system alternatives are in lieu of the existing sea water intake, underground, and outfall facilities, either of these alternative cooling systems would be an addition to the AFC-proposed plant design. As such, when compared to the plant design proposed in the AFC, they would add noise sources and aggregate plant noise emissions. These potential additional noise impacts were investigated to determine a first-order assessment of the changes due to alternative cooling. Noise level information was received from manufacturer[7] documentation and used to assess the additional plant emissions. This noise level information was engineering data only and is not fully qualified, nor contractually guaranteed by the vendor. As such, there is some potential for error in using these values, but they were, nonetheless, deemed adequate for this first-order evaluation.

For the ACC option, the vendor calculated an engineering noise level estimate of approximately 46 dBA at 400 feet from the periphery of each air-cooler bank (there would be two such banks for the ACC alternative). For the Hybrid system, the vendor calculated an engineering noise level estimate of approximately 44 dBA at 400 feet from the edge of the equipment envelope of each air-cooler-plus-cooling-tower system[8] (there are two such systems for the Hybrid alternative). These vendor noise levels are considered to be ‘best-case’ values that are at the limit of achievable noise reduction methods for this type, size, and service of cooling system.

The same basic prediction methodology as used for the AFC was employed for this investigation as well as the physical configuration of equipment, berm, and wall barriers. The predicted noise levels at the same receptor locations used in the October 2000 AFC were calculated and compared to the aggregate noise impacts from the AFC-proposed plant design. Thus, the changes in noise solely from the use of the ACC or Hybrid alternative cooling were found. The results of these calculations are summarized in the tables presented in Appendix G.

4.3.1 ACC Alternative

For the ACC alternative, the nominal increase at residential and sensitive receptors is +1 dB (compared to the AFC design). However, the change to the (LORS-critical) RV Park receptor location (and, by interpolation, the closest areas of the creek/wetlands areas) is shown as +0 dB. At the tourist areas to the west, northwest, and southwest of the project site, the nominal increase is +2 dB. For this option, all identified receptor areas are still within compliance of the pertinent regulatory limits, but the Scott Street location has now joined the RV Park as a second critical

[7] The potential vendor contacted for these analyses was GEA Power Cooling Systems, Inc.
[8] Note that this value does <u>not</u> include the circulating cooling water pump trains, which are typically not part of a cooling tower scope-of-supply .

receptor (i.e., future noise is predicted to be right at the Noise Element limit). Please note that to even reach these aggressive noise results, an increased cost ACC package would be required. These increased capital costs are reflected in Table 1.

4.3.2 Hybrid Alternative

For the Hybrid system, the nominal increase for this cooling option at the residential and sensitive receptors is +4 to +5 dB. This is mostly due to the cooling tower water pumps, even though they are assumed to be "quiet-design" units. As with the ACC option, the change at the critical RV Park is shown to be +0 dBA (again, due to residual barrier attenuation effects in that direction). The general increase at residential/sensitive receptors means that two locations are now predicted to be out of compliance with the Noise Element limits – these are locations 2 (Scott Street) and 6 (First Church[9]). Furthermore, location 4 (Radcliff & Berwick) is now a critical receptor right at the Noise Element limit. At the tourist areas, the increase will be substantial -- upwards of +10 dB at some locations. This increase is from the cooling water pumps and lack of substantial barrier benefits in the direction of the tourist-related areas. For the Coleman Park location, this cooling alternative can be expected to yield noise levels that are comparable to the existing power plant environment.

In summary, the best-case analysis for noise impacts shows a slightly increased, but still compliant, situation for the ACC option. However, the marginal acceptability at the closest receptors to the project site has been reduced by the ACC addition. Further, this analysis uses preliminary vendor data and when further detailed design and engineering becomes available, these parameters may not be attainable. If any of the assumptions behind the best-case configuration later prove to be overly optimistic and/or unattainable in the actual installation, then noise compliance may be compromised, with little or no mitigation recourse. For the Hybrid option, the evaluation shows noise levels that can be expected to fail the city's Noise Element limits at one or more receptor locations (again, this is for the assumed best-case conditions). However, unlike the ACC option there may be additional (potentially expensive) mitigation measures that could be considered during detail design to potentially reduce the noise emissions from these predominant sources.

In short, both the ACC and Hybrid cooling alternatives are, at best, problematic for achieving future noise compliance and are less beneficial when compared to the AFC-proposed project design. Given the results of the noise analysis, Duke management does not have confidence that the noise limits can be met with the ACC system.

4.4 Air Quality Impacts

Sierra Research reevaluated worst-case air quality impacts using the same operating assumptions that were used in the AFC. The modeling analysis (see Appendix H for more details) concluded that due to the distance between the stacks and the new cooling structures, the ACC alternative had no effect on maximum modeled impacts. The addition of cooling towers in the Hybrid system resulted in increases in ambient PM_{10} impacts over both the proposed project and the ACC cooling alternative.

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[9] It should be noted that this location is no longer a functioning church and that the general surrounding area is predominantly commercial/hotel usages.

With respect to the Hybrid alternative, the wet cooling towers associated with the hybrid system tend to generate visible water vapor plumes. As the wet cooling towers would be operated on a continuous basis, the frequency with which these plumes would be generated will probably be greater than the frequency predicted for the HRSG plumes associated with the proposed project.

4.5 Land Use Impacts

California Environmental Associates has evaluated potential land use impacts associated with the alternative cooling scenarios. As noted above, even the minimum configuration required to accommodate either alternative cannot be built within the boundaries of Duke's current site. To accommodate the large dry cooling condensers and/or towers at a best-engineering appropriate location, a portion would have to be built on PG&E property (see Appendix E). Duke does not currently own this property, nor is there any suggestion that PG&E would be willing to reconfigure the switchyard to accommodate such a need. Even if such an option could be technically achieved, the costs are unknown at this time, but could be many millions of dollars.

There are multiple policies in the Certified Land Use Plan and General Plan that call for protecting and improving the visual corridors in Morro Bay. For example, LCP Policy 5.01 states: "....power plant expansion on PG&E owned property shall have priority over other coastal dependent industrial uses. Power plant expansion shall be limited to small facilities whose location would not further effect the views of Morro Rock from State Highway One and high use visitor-serving areas, consistent with Policy 12.11." Given the size, height, and location restraints presented by the air cooling alternatives, were either option to be required, there would be at least nine specific conflicts with existing land use regulations and ordinances. See Appendix I for a complete discussion.

While the MBPP modernization and replacement project, as originally proposed in the AFC, complies with the height requirements outlined in the City of Morro Bay Municipal Code Section 17.24.150, an air-cooled or hybrid system would not comply because these additional structures would be considered a "new" facility. Accordingly there would be a non-conforming use due to the height limit that would only be permitted through a city council approved change to the current ordinance.

4.6 Terrestrial Biology Impacts

The Huffman Broadway Group, Inc. (HBG) has evaluated the terrestrial biology impacts of the two alternative cooling methods. Plot plans (see Appendix D) indicate that although both alternatives result in larger facility footprints than the proposed project, these additional facilities would be sited on industrialized areas that are currently utilized by the MBPP or PG&E (PG&E switchyard). Both of these areas have minimal habitat value. Based on the plot plans, neither alternative would result in substantially different terrestrial habitat impacts when compared to the proposed project. However, were it to be technically infeasible to utilize PG&E property, this would require a shift of the cooling facilities to the west. This would lead to significant constraints and for the air cooled condenser system could possibly lead to negative impacts to the coastal dune scrub Environmentally Sensitive Habitat Area (ESHA) if the footprint intruded into this area.

Air quality analyses of the two alternatives, conducted by Sierra Research, indicate that overall there were no significant changes to the modeled pollutant values related to these alternatives when compared to the proposed project. Therefore, no significant adverse impacts to terrestrial biological resources related to air quality are expected as a result of either of these alternatives.

Noise analyses indicated that neither alternative results in an increase in noise at the Morro Creek ESHA as compared to the proposed project. This is due to the potential shielding by either the heat recovery steam generation system (HRSG) and/or the northern berm and the proposed sound wall. In general, predicted increases in decibel levels at receptor locations to the west, northwest and southwest related to the ACC alternative are not significant. Predicted increases in decibel levels at receptor locations to the west, northwest and southwest related to the Hybrid alternative would be greater than those calculated for the ACC alternative, however, would also not be significant. Increases in noise levels at the Coleman Park location, which is adjacent to dune scrub ESHA, would be comparable to the existing ambient noise level under the Hybrid alternative. Neither noise levels from the proposed project nor increases related to the Hybrid cooling alternative would be expected to interfere with breeding behavior of peregrine falcons at Morro Rock, since both the proposed project and the hybrid cooling alternative noise levels are below the existing ambient noise level at Morro Rock. In summary, no significant adverse impacts to terrestrial biological resources are expected as a result of predicted noise levels of either of the two cooling alternatives.

See Appendix J for a complete discussion of the issues.

4.7 Morro Bay Community Concerns

Throughout the AFC preparation process over the past two years, Duke has heard repeatedly from both City leaders as well as the general public that it is critical to minimize the height and bulk of the power plant. Views from the surrounding hillside residences of both the ocean and Morro Rock are highly valued. A sampling of quotes from various City meetings and resolutions is shown below as examples of the City's position.

"…and replace the old plant in two phases with a state of the art, low profile facility." (Staff Report to the Mayor and City Council. December 10, 1999.)

"Whereas, in November 2000, the voters of the community expressed their strong support for the removal of the existing plant and construction of a new, less obtrusive, more efficient, modern facility…" (City of Morro Bay. Resolution No. 22-01: *Resolution of the City Council of the City of Morro Bay, California*. Morro Bay, CA.)

"…and its replacement with a substantially smaller, less visually obtrusive facility." (City of Morro Bay. Resolution No. 57-01: *Resolution Regarding Alternative Cooling Methods Proposed for the Morro Bay Power Plant*. Morro Bay, CA.)

"…to reduce the visual obtrusiveness of the new facility." (City of Morro Bay. Resolution No. 57-01: *Resolution Regarding Alternative Cooling Methods Proposed for the Morro Bay Power Plant*. Morro Bay, CA.)

"I have no problem with the CEC analyzing enclosure. What I have a problem with is that it seems to me to be not what our residents indicated they wanted at the very beginning, which was less bulk and more view of the ocean and the Rock." (Janice, Peters, Morro Bay City Council Member, November 13, 2001, Morro Bay City Council Meeting)

The Duke team also believes that minimizing the height and bulk of the new power plant is consistent with minimizing overall visual impact. Our analysis shows that a low profile, open plan maximized views through the power plant site to the ocean and Rock, and is therefore recommended. Both of the alternative cooling scenarios involve increasing the height and bulk of the facility and therefore do not address the concerns of the City of Morro Bay nor those of its citizens.

Another key concern of the City Council is their strong desire that the Duke facility maintain its current seawater cooling system. The use of Duke's discharge tunnel and the co-mingling of Duke's discharge with the discharge from the City's desalination plant is mandated by the City's current NPDES permit.

4.8 Economic Impact

The previous methodology employed to compare the relative economic costs of alternative technologies has been refined. Specifically, a more direct and improved method for economically evaluating the loss in efficiency as a result of the alternative cooling systems has been used. Also, improvements have been made to the duty cycle.

In the prior analysis, the economic cost of the efficiency loss resulting from the cooling alternatives was evaluated using a constant fuel-input rate. The current analysis uses a more straightforward approach by evaluating the incremental fuel requirements for the alternatives keeping their net-output equal to the net-output of a once-through cooled plant. The economic cost of the loss in efficiency is then simply the increased cost of fuel. The incremental fuel requirements are evaluated over the current duty cycle (Appendix L). The fuel usage of a once-through cooled plant and each alternative (for a constant output) are shown in Appendix M.[10] The incremental annual fuel use for both the ACC and Hybrid cases is approximately 900,000MMBtu/yr. The resultant incremental annual energy cost is about $4 million based on a mean projected future natural gas cost of $4.23/MMBtu.

The current duty cycle is based on the air permit, which allows up to 400 hours of startup, 4000 hours of duct firing limited to no more than 16 hours a day, and 4000 hours of non-duct firing each year. For purposes of this analysis we have eliminated the 400 hour startup consideration, which makes the analysis more conservative. Duke also corrected deficiencies in the three temperature points (summer peak, summer average, and remaining) selected for the previous

[10] For the purpose of this analysis, Duke made the simplifying assumption that the increased fuel usage is equivalent for both alternatives. Based on experience, Duke expects the Hybrid alternative to consume slightly more fuel for a given output. Additional engineering would need to be done to understand the magnitude of the difference. Duke believes this conservative assumption is appropriate in the context of the accuracy of the overall analysis.

duty cycle. First, the summer average temperature was understated because the annual mean high temperature was used rather than the mean high during just the summer months. Second, distinct summer average and peak temperature points do not provide additional resolution because of the infrequency with which the peak temperature occurs (< 30 hrs/yr). The current annual duty cycle, as outlined in Appendix L, is based on two temperature points and reflects the air permit limits.

The incremental economic costs for the alternative cooling technologies from the current analysis are summarized in Tables 3 and 4. A discussion of the results is presented in Appendix N. It should be noted that these results are site specific. If an air cooled or hybrid cooled plant was constructed in another location which did not have the moderate, relatively constant ambient temperature of Morro Bay, the economic impact will be very different. For example, if an alternatively cooled plant was constructed in an inland environment, such as Fresno, the economic impact would be significantly greater because of the ambient condition variability and larger temperature extremes.

Table 3: Air Cooled Condenser Summary Economic Cost Results (in millions)

Total Capital Cost[a]	Incremental O&M Cost ($/YR)	Incremental Energy Cost ($/YR)	Total Annual Cost ($/YR)	Present Value	Amortized Annual Cost ($/YR)
$55 - $60	**$0.3**	**$3.8**	**$4**	**$106 - $111**	**$9**

a. incremental

Table 4: Hybrid Wet/Dry Cooling Summary Economic Cost Results (in millions)

Total Capital Cost[a]	Incremental O&M Cost ($/YR)	Incremental Energy Cost ($/YR)	Total Annual Cost ($/YR)	Present Value	Amortized Annual Cost ($/YR)
$56 - $61	**$0.5**	**$3.8**	**$4**	**$109 - $114**	**$9**

a. incremental

In brief, key economic conclusions of this analysis are:

- The economic impact of the alternatives were evaluated on an incremental Present Value (PV) and annual cost basis. The Present Value encompasses the capital cost of the alternative, the annual O&M costs, and the value of reduced plant efficiency expressed as the cost of additional fuel required for the plant to equal the net output of the once-through cooling base-case (Figure 1).

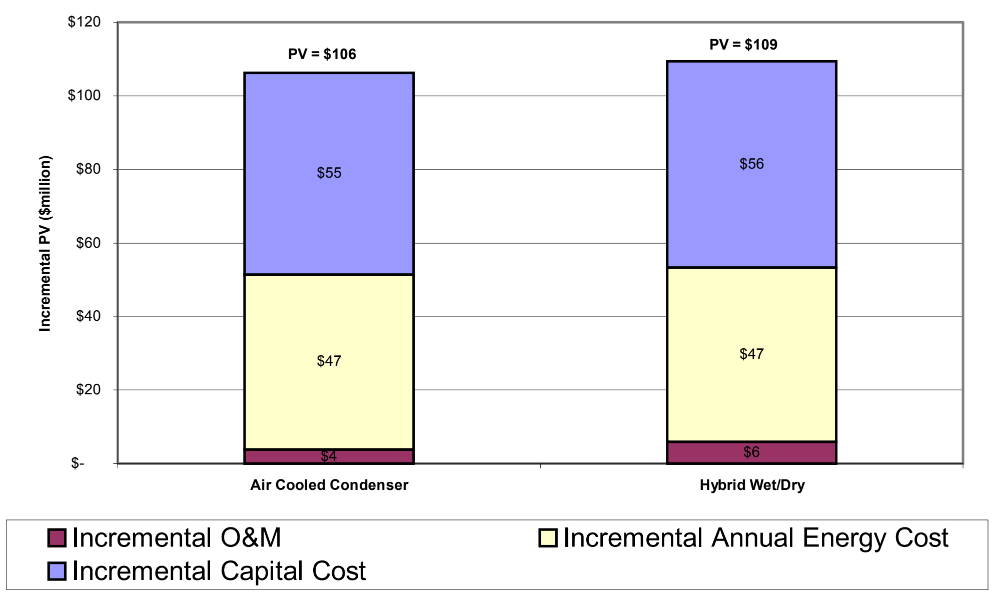
- For air-cooled condensers the incremental PV costs were estimated to be $106-111 million, equivalent to $9 million on an annualized basis.

- For the hybrid wet/dry alternative the incremental PV costs were estimated to be $109-114 million, equivalent to $9 million on an annualized basis.

- A Hybrid Wet/Dry cooling system has roughly the same economic impact as an Air Cooled Condenser while introducing additional equipment complexity and water availability issues. For these reasons, the Hybrid is the less desirable option.

- Duke concludes that the economic impact of alternative cooling systems are still disproportionate to the probable benefits.

Figure 1: Present Value Composition



5 Conclusions

This paper summarizes Duke's best available information concerning the costs, environmental impacts and other constraints of two possible alternatives to the proposed project's seawater cooling system. It is Duke's opinion that even if any such alternative could be constructed (an open question), that it would be less protective of the environment than Duke's proposed project.

To carry out this analysis, Duke built upon our original analysis and changed assumptions and methodology as appropriate to account for our evolving understanding of various attributes of each alternative. Duke's estimates of economic costs have been derived by contractors and vendors using their best engineering judgments rather than from detailed drawings and plans. Accordingly, the magnitude of these costs is most probably understated.

To summarize the key attributes of both alternatives:

1. Neither the air-cooled nor hybrid alternative could be constructed within the footprint constraint of Duke's current site.

2. Neither the air-cooled nor hybrid alternative would comply with several ordinances and regulations (LORS) with respect to negative visual impacts of new structures on the coast of California.

3. Neither the air-cooled nor hybrid alternative is consistent with the strongly expressed desires of the community with respect to the visual impacts of the project.

4. When compared to Duke's proposed project, both alternatives would have negative visual, and noise impacts.

5. It is not clear that it is even feasible to construct either alternative, given the site constraints and required earthquake standards. Were these limitations to be fully analyzed, project costs are expected to be significantly higher.

6. While the estimated costs of both alternatives is considerably less than in our previous analysis, even the reduced incremental costs of either alternative ($106-$114 million on a Net Present Value basis) are wholly disproportionate to relatively modest marine biology benefits from reduced use of seawater cooling.

7. Hybrid cooling represents the worst of both worlds: Increased complexity over air-cooled condensers means lower reliability for about the same cost, and it is premised on availability of make-up water that is far from certain.

Finally, were such a cooling system to be required by CEC as a condition of certification, it would jeopardize the project and, at a minimum, would require renegotiation of Duke's agreement with the City of Morro Bay because total project costs would be prohibitive when considered in the context of the various economic benefits (such as voluntary tear down of the existing plant) that have been offered to the City.

Appendix A – Key Assumptions Matrix

Issue	Previous Analyses	Current Analysis	Explanation
Net plant output of plant with alternative cooling systems	Design and condenser configuration not capable of producing 1200 MW over ambient conditions with alternative cooling systems.	Design plant to produce 1200MW net over ambient conditions with alternative cooling systems[11]	The Proposed Project is a nominal 1200MW output, so analysis should reflect this.
Valuing reduced efficiency of alternatives	Use hypothetical make-up plant as value proxy for reduced efficiency (loss in net output) while fuel input remains constant.	Value increased fuel use to account for reduced efficiency while maintaining output of alternative and once-through cooled plants equal.	Current analysis is a more straightforward method of valuing efficiency loss.
Discount Rate	7%	7%	By direction of RWQCB.
Project Life	30 Years	30 Years	By direction of RWQCB.
Annual Duty Cycle	2,602 hr @64^{o}F 26 hr @ 85^{o}F 5,256 hr @ 57^{o}F All at constant fuel input	1,952 hr @68^{o}F 1200MW 2048 hr @ 57^{o}F 1200MW 976 hr @ 68^{o}F 996MW 3024 hr @ 57^{o}F 1021MW	Current duty cycle reflects operation limits set by air permit and ambient conditions.
Natural gas price	$5/MMBtu	$3.05/MMBtu MIN $4.23/MMBtu AVG $4.89 /MMBtu MAX	Current price reflects likely future price range based on forward market data.
Air Cooled Condenser Incremental PV	$301MM	$106 to $111 MM	Lower PV a result of change in valuing efficiency impact and changes to underlying capital costs.

[11] Technically there is a limit to how much fuel can be injected into the HRSG to make up for the lost efficiency of the alternatives at high ambient temperatures. This constraint only surfaces at high temperatures of around 85 degrees where output cannot be maintained at 1200MW. This will have a negligible impact on the analysis because of the relatively few hours per year of very high ambient temperatures.

Issue	Previous Analyses	Current Analysis	Explanation
Air Cooled Condenser Incremental Amortized Annual Cost	$24MM	$9 MM	Result of lower PV.
Air Cooled Condenser Absolute Capital Cost	$64MM	$80 to $85 MM	Larger condensers required for plant to produce 1200MW net output over ambient temperature range. Also, low noise package added.
Air Cooled Condenser Incremental Capital Cost	$39MM	$55 to $60MM	Larger condensers required for plant to produce 1200MW net output over ambient temperature range. Also, low noise package added to design costs.
Air Cooled Condenser Absolute O&M Cost	$0.6MM	$0.6MM	Small influence on PV so assumed to be the same.
Air Cooled Condenser Incremental O&M Cost	$0.3MM	$0.3MM	Small influence on PV so assumed to be the same.
Air Cooled Condenser Annual Energy Cost	$14MM	$4MM	Change in valuation methodology and changes in fuel cost and plant heat rate.
Hybrid Wet/Dry Cooling Incremental PV	$273MM	$109 to $114 MM	Lower PV a result of change in valuing efficiency impact and changes to underlying capital costs.
Hybrid Wet/Dry Cooling Incremental Amortized Annual Cost	$22MM	$9 MM	Result of lower PV.
Hybrid Wet/Dry Cooling Absolute Capital Cost	$61MM	$81to $86 MM	Smaller cooling tower in current design, but investment required to upgrade WWTP.
Hybrid Wet/Dry Cooling Incremental Capital Cost	$36MM	$56 to $61MM	Smaller cooling tower in current design, but investment required to upgrade WWTP.

Issue	Previous Analyses	Current Analysis	Explanation
Hybrid Wet/Dry Cooling Absolute O&M Cost	$0.8MM	$0.8MM	Small influence on PV so assumed to be the same.
Hybrid Wet/Dry Cooling Incremental O&M Cost	$0.5MM	$0.5MM	Small influence on PV so assumed to be the same.
Hybrid Wet/Dry Cooling Incremental Annual Energy Cost	$12MM	$4MM	Current energy cost lower as a result of hypothetical "make-up" plant's lower heat rate, lower fuel price, and equal net-output methodology.
Hybrid cooling tower make-up water requirement	5,000 GPM seawater	1,400 GPM Reclaimed Water from the WWTP	Desire to eliminate use of any seawater in alternatives in order to minimize air quality and biology impacts. Most practical source for a sufficient quantity of fresh water is WWTP. Limited freshwater supplies set available makeup rate. No desalination capability.
Temperature limit of HRSG	Original HRSG limited to 1450°F	Redesigned HRSG limited to 1550°F	Up to 60 MW additional output at high ambient temperatures with minor HRSG cost increase.
Air Cooled Condenser Design Criteria	Specification at 64°F ambient	Specification at 85°F ambient to maintain steam turbine exhaust pressure below 7.0"HgA equipment limitation.	Considering normal steam turbine exhaust pressure limitation.
Air Cooled Condenser Noise	Standard Air Cooled Condenser Equipment	Low-noise package from GEA	Standard ACC not capable of meeting City noise requirements, so add low noise package in an attempt to meet requirements.

Appendix B – Previous Analysis Presented in the 316 (b) Report

PREVIOUS CAPITAL COST AND SIZE ESTIMATES

Evaluating the alternatives at the conceptual level enabled Duke to quickly obtain quotes and preliminary equipment sizing from vendors. Given the vendor information, Duke evaluated four possible plot configurations, estimated economic costs, and evaluated probable efficiency impacts of the alternative cooling systems. The estimated capital and O&M costs for the alternatives are summarized in Table 1.

The incremental cost numbers represent the net increase in costs compared to the baseline (once-through cooling). These costs were calculated by subtracting the baseline cost from the alternative cooling cost.

Table 1: Previous Capital and Annual O&M Cost Estimates (in millions)

	Capital Cost		Annual O&M[a]	
Alternative	**Absolute**	**Incremental**	**Absolute**	**Incremental**
Once-through cooling (Base Case)	$25	$0	$0.3	$0
Air Cooled Condenser	$64	$39	$0.6	$0.3
Hybrid Wet/Dry Cooling	$61	$36	$0.8	$0.5

a. excludes energy cost to run fans and other equipment

PREVIOUS ECONOMIC IMPACT

The plant efficiency impacts of the alternatives were calculated keeping the fuel (gas) consumption constant. This enabled Duke to evaluate the net plant output differences, in megawatts, between the alternatives and thus estimate the resultant economic impact. The difference in plant net-output between a once-through cooled plant and the alternatives was evaluated at the three temperature points in the duty cycle (Appendix K). The economic cost of the reduced output was determined by using a hypothetical "make-up" plant as a value proxy. The economic cost reflected the capital cost to build the "make-up" plant (sized to meet the maximum reduction in net-output of the alternatives) and the annual fuel cost for the "make-up" plant (assumed plant's output over the duty cycle was exactly equal to the difference in output of a once-through cooled plant and the alternatives). The resulting capital and annual fuel cost of the "make-up" plant are shown in Table 2.

Table 2: "Make-up" Plant Cost Estimates (in millions)

	Capital Cost		Annual Fuel Cost	
Proposed Plant Cooling System	**Absolute**	**Incremental**	**Absolute**	**Incremental**
Once-through cooling (Base Case)	$0	$0	$0	$0
Air Cooled Condenser	$82	$82	$14	$14
Hybrid Wet/Dry Cooling	$80	$80	$12	$12

PREVIOUS RESULTS AND CONCLUSIONS

The initial evaluation resulted in two key findings. First, the plot space available for either cooling alternative was inadequate on two levels. First, it was not clear that a plant using one of the alternative cooling methods could be constructed within the given site and if it could, the project would not minimize the down time between shutdown of the existing plant and startup of the new plant. Second, the megawatt loss and resultant economic cost of the alternatives relative to once-through cooling are wholly disproportionate to any potential biological benefit. For these reasons, Duke concluded that an alternative cooling system would be an unacceptable alternative to once-through seawater cooling.

The following bullets provide more background on how Duke came to this conclusion.

PLOT SPACE

- The total plot space available for the plant is both limited and complex. There are many constraints on equipment placement that severely limit, if not preclude, most if not all, placement options on the available portion of the site.

- The planned plot space has been optimized for both equipment configuration and noise mitigation. It will be difficult to change the location of the plant without increasing environmental impacts from the facility.

- The air-cooled condensers (included in both alternatives) must be kept as close to the steam turbine as possible. Failing to do this creates tremendous back-pressure (economic) inefficiencies and would require a disproportionately large duct pipe size to transmit steam to the condensers. These two factors challenge the very constructability of any of these alternatives.

- The only viable location for the air coolers is to place them immediately above the seawater return tunnels. However, this location presents serious constructability issues and also introduces the risk of interrupting the existing plant's operations.

ECONOMIC

- The maximum loss in net output for the alternatives is estimated to be 102MW for Air Cooled Condenser alternative and 100MW for the Hybrid Wet/Dry Cooling alternative.

- The resultant incremental economic cost for the alternatives is summarized in Tables 3 and 4.

- If a rigorous engineering design was undertaken for these alternatives, it is likely that a larger, even more expensive system would result.

Table 3: Air Cooled Condenser Summary Economic Cost Results (in millions)

Total Capital Cost	Incremental O&M Cost ($/YR)	Incremental Energy Cost ($/YR)	Total Annual Cost ($/YR)	Present Value	Amortized Annual Cost ($/YR)
$120	$0.3	$14	$15	$301	$24

Table 4: Hybrid Wet/Dry Cooling Summary Economic Cost Results (in millions)

Total Capital Cost	Incremental O&M Cost ($/YR)	Incremental Energy Cost ($/YR)	Total Annual Cost ($/YR)	Present Value	Amortized Annual Cost ($/YR)
$116	$0.5	$12	$13	$273	$22

Appendix C – Analytical Framework & Document History

Table 1: MBPP Proposed Project: Simulation History

CONFIGURATION			AMBIENT TEMPERATURE				
Number of CTG	CTG LOAD	DUCT BURNER	34° F	57° F	64° F	68° F	85° F
2	50%	Unfired	AFC:1	AFC:1			AFC:1
2	75%	Unfired	AFC:1	AFC:1			AFC:1
2	100%	Unfired	AFC:1	AFC:1 NEW:1		NEW:1	AFC:1
2	100%	Fired	AFC:1	AFC:1 PRV:1 NEW:1,2,3	PRV:1,2,3	NEW:1,2,3	AFC:1 PRV:1,2,3
2	100%	Partial Firing[a]		NEW:2,3		NEW:2,3	

a. Duct burner of ACC/Hybrid cooled plant fired such that net output is equal to once-through plant with no duct firing

AFC	*Simulation for AFC*	**1**	***Once-through cooling***
PRV	***Simulation for basis of 316(b) "Resource Assessment Report" impacts (note: simulations performed at a conceptual level with a commensurate level of precision)***	**2**	***Hybrid Wet/Dry Cooling***
NEW	***New simulation for the analysis in this document***	**3**	***Air Cooled Condenser***

Document History

- Duke initially evaluated the feasibility of alternative cooling technologies for the proposed MBPP project as part of the development of the 316(b) Resource Assessment Report.
- May 11, 2001: Draft of 316(b) Resource Assessment Report submitted to the TWG (Technical Working Group) and the RWQCB (Regional Water Quality Control Board).
- June 29, 2001: Refined economic analysis submitted to the RWQCB in response to a request from the RWQCB to further explain the economic considerations.
- July 2, 2001: Copy of Refined Economic Analysis report sent to the CEC
- July 10, 2001: Final 316(b) Resource Assessment report, incorporating the refined analysis, submitted to the CEC, RWQCB, and TWG .
- July 12, 2001: The results of the alternative cooling analysis at the RWQCB workshop.

- August 9, 2001: “Evaluation of Alternative Intake Technologies – Air-Cooled Condensers” report delivered to the City of Morro Bay on with copies sent to CEC, RWQCB, and CCC . It provided additional information concerning the regulatory basis for alternative cooling technology evaluations, the technology review that was conducted, information related specifically to the Air-cooled Condenser technology, and our conclusions. Report created in response to request for additional information on dry cooling from Morro Bay City Council on August 3, 2001.

Appendix D – Plot Plans

Insert Plot Plans Here

Insert Plot Plans Here

Appendix E – Site Constraints PowerPoint Slides

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Appendix F – Visual Impacts

This visual analysis supersedes previous analyses on cooling alternatives for the Morro Bay Power Plant. Earlier analyses, done in October and November of this year, were based upon preliminary designs that have since been found not to meet noise requirements. Since then, conceptual designs have been revised and the size of the required equipment has increased. The air-cooled condensers (ACCs), which are essentially thirty-foot diameter fans, were slowed-down to reduce noise. The slower fans reduced cooling air volume and resulted in the requirement for more fans with larger enclosures. This analysis evaluates the visual effect of the revised design alternatives for cooling.

DESCRIPTION OF COOLING ALTERNATIVES

Two cooling alternatives are potentially available for the Morro Bay Power Plant. The first air-cooled alternative utilizes a large array of air condensers and the other, the hybrid alternative, utilizes a smaller array of air condensers plus two cooling towers. This visual analysis focuses on the first alternative, the large array of air condensers because the potential impacts of the larger size. Simulations of the large array of ACCs follow this discussion.

Air-Cooled Alternative

The air-cooled alternative abandons the water intake structure; outfall and all other underground facilities associated with water transfer and requires construction of two air-cooled condenser enclosures as part of the facilities. The number of units, as well as the dimensions of the units themselves were determined from manufacturer budget quotes appropriate in terms of meeting the cooling requirements for the proposed power-generation facility and limiting noise generation to attempt to meet required standards.

Each condenser enclosure measures 185' (W) x 320'(L) with a vertical height of 110' to the top of the steam header. From the ground up to the first 65'-70' is open steel structure while the remaining 40'-45' is a shrouded box to enclose "A" frame condensers. The ACC enclosure units are located approximately 285’ south of the nearest proposed HRSG units. (See site plan).. Plumes are not associated with this type of cooling.

Hybrid Cooling Alternative

The Hybrid alternative is similar to the air-cooled option requiring two smaller ACC units sited in roughly the same location, but also adds two, two-cell cooling towers adjacent to the ACC units (See attached plan). Each ACC enclosure unit measures 225’ (W) x 225’ (L), with a vertical height of 105’ to the top of the steam header and matches the ACC units from the dry-cooled option in appearance and structure. Each cooling tower structure measures 36’ (W) x 72’ (L) with a vertical height of 40’. Plumes could emanate from these towers on winter mornings or other periods of cool weather and high humidity.

Table 1 below lists component dimensions for both alternatives.

Table 1: Design Alternative Component Dimensions

Design Alternative	Air-Cooled		Hybrid Cooling (not simulated)		
Plant Components	**ACC Unit**	**Stack**	**ACC Unit**	**Stack**	**Cooling Tower**
(L) Length in ft.	320	NA	225	NA	72
(W) Width in ft.	185	NA	225	NA	36
(H) Height in ft.	110	145	105	145	40
(D) Diameter in ft.	NA	18	NA	18	NA

METHODOLOGY FOR VISUAL SIMULATIONS

This visual analysis of cooling alternatives was based on a set of four visual simulations. A visual simulation uses a digital photograph of existing scenery and overlays a three-dimensional, rendered computer model of the equipment as viewed from the same location. The result is a photo-realistic representation of the design alternative as it would appear from a selected Key Observation Point, or KOP. The visual simulations reflect a high level of accuracy regarding footprint, dimensions, and location but do not reflect final engineering design decisions (siting, structure, materials, finishes etc.). They are artists' extrapolations based on schematic engineering data as thus far determined by the applicant as well as reference material (e.g., photographs and literature of similar air-cooled condensers). See Attachment 6.13 – 2 in the AFC for a more detailed description of visual simulation process

CRITERIA FOR VISUAL ANALYSIS

This analysis compares the Project as proposed in the AFC, with the visual change incurred as a result of the addition of cooling equipment described above. Each KOP simulation was evaluated by a set of four criteria:

- Area occupied by the power plant and the new cooling equipment
- Area penetrating skyline (extending above horizon)
- Horizontal field of view (width of area occupied by the power plant)
- Obstruction of features (Views of the Rock, Ocean, Beach or Distant hills that would otherwise be visible)

SELECTION OF KEY OBSERVATION POINTS (KOP'S)

The evaluation of cooling alternatives relies on four KOP's (7, 8, 14, 15) as the most appropriate from which to determine visual impacts. The four selected KOP's have been used in previous representations and were selected to provide views of the air condensers from different representative perspectives, specifically:

- KOP 7 Near view from beach, increased public access, condensers visible
- KOP 8 View from west, representative of view from water
- KOP 14 Representative view from neighborhoods on hillside to northeast.

- KOP 15 Residential view, from hillside to east.

ANALYSIS OF KOP'S

KOP 7: Close-up view from Embarcadero Road
Looking ESE from south of Morro Creek

This is a scenic vista point as referenced in the LCP and is a public coastal access point. Mainly local residents and fishermen use the unpaved public parking area. This is the future site of the Embarcadero road connection. This site provides a close range public view of the Project design alternative.

The visual effect of the air-cooled alternative from this perspective is the near view of large air condenser enclosures rising above the skyline that block ridgeline views of the coastal hills and the City of Morro Bay itself. Details of the structure and components will be clear. The horizontal field of view occupied by the power plant will nearly double when compared to the water-cooled option.

KOP 8: View from Coleman Drive
Looking NE across inlet from Morro Rock

Local residents, visitors, and boaters coming into Morro Bay Harbor see this view. This is a full view of the MBPP property looking northeast from Coleman Drive at the base of Morro Rock.

At a height of 110 feet, the air-cooled enclosures would be the largest structures visible, and would block views to the grassy coastal hills in the distance. They would not rise above the skyline, but would increase the industrial bulk visible on the site and increase the horizontal field of view occupied by the power plant.

KOP 14: View from Sunset Plateau
Looking SSW from vacant lot at end of Sunset Court

Panoramic views from Sunset Plateau include a broad expansive view of the ocean and the coastline to the north (not visible in image) as well as views directly onto the Project site. This neighborhood also overlooks Highway 1, which is visible in the middle ground.

The air-cooled enclosures would extend above the horizon, obstructing views of the estuary, the sand spit, the ocean, and some trees in the distance. This alternative would increase the horizontal field of view by introducing the taller air condenser enclosures throughout most of that field. Some existing trees in the foreground, plus proposed landscaping, could partially screen the lower half of the air condensers, but would not screen that portion which protrudes above the skyline.

KOP 15: View from Harbor Front Tract
Looking West down Radcliffe Street from Berwick Drive

Views from the Harbor Front Tract residential area include Morro Rock, the power plant, transmission towers, and the ocean. To the south are the harbor inlet and the northern tip of the sand spit. Residential structures in the area both frame views and obstruct potential panoramic views. This location is near a scenic vista point referenced in the LCP.

The air-cooled condenser enclosures are the largest structures visible from KOP 15. This alternative would widen the horizontal field of view occupied by the power plant to where the condensers begin to obstruct views of Morro Rock and the ocean.

SUMMARY

The Project as defined in the AFC is smaller in height and bulk, and occupies less of the coastal site than the air-cooled alternative. The air-cooling alternative requires the large array of air condensers in an enclosure which, when evaluated against the visual criteria, consistently caused a significant negative visual effect. Specifically, the negative visual effects of adding air cooling equipment to the MBPP include; (1) a significant increase in the total area occupied by the power plant, (2) Significant increase in the area penetrating the skyline or obstructing coastal features, and (3) Significant increases in the horizontal field of view occupied by the power plant. Each of these findings is inconsistent with the City of Morro Bay's expressed desire to minimize the height and bulk of the facility.

INSERT KOPs HERE

INSERT KOPs HERE

INSERT KOPs HERE

INSERT KOPs HERE

Appendix G --Noise Impacts

INTRODUCTION

This document summarizes an additional noise impact assessment conducted for two alternative plant-cooling options for the MBPP Project. Rather than using the existing once-through (sea) water cooling system for the proposed plant, two optional alternative cooling systems have been investigated. One option is to use a dry, air-cooled condenser ("ACC") array for each power block (two arrays total), while the second option would employ a combination of dry ACC arrays coupled with wet cooling towers and is known as a "Hybrid" system. The details of each cooling alternative are given in other sections of the Alternatives discussion.

BACKGROUND

Since these two cooling system alternatives are in lieu of the existing sea water intake, underground, and outfall facilities, either of these alternative cooling systems would be an addition to the AFC-proposed plant design. As such, they would add noise sources and aggregate plant noise emissions, when compared to the plant design proposed in the AFC. These potential additional noise impacts were investigated to determine a first-order assessment of the changes due to alternative cooling. Noise level information was received from manufacturer[12] documentation and used to assess the additional plant emissions. This noise level information was engineering data only and is not fully qualified, nor contractually guaranteed by the vendor. As such, there is some potential for error in using these values, but they were, nonetheless, deemed adequate for this first-order evaluation.

The vendor calculated the size, configuration, and operations characteristics of each system to meet the necessary cooling capacity, while minimizing visual, plume, noise, and power consumption impacts. For the ACC option, the vendor calculated an engineering noise level estimate of approximately 46 dBA at 400 feet from the periphery of each air-cooler bank (there would be two such banks for the ACC alternative). For the Hybrid option, the vendor calculated an engineering noise level estimate of approximately 44 dBA at 400 feet from the edge of the equipment envelope of each air-cooler-plus-cooling-tower system[13] (again, there are two such systems for the Hybrid alternative). These vendor noise levels are considered to be 'best-case' values that are at the limit of achievable noise reduction methods for this type, size, and service of cooling system.

ANALYSES

These estimated far-field system noise levels were converted into individual noise source inputs to better define the spatially-distributed nature of the fan arrays. Although the bottom of the ACC open steel structure is 65 to 70 feet above the ground (with 40 to 45 feet above that consisting of a shrouded enclosure), the nominal noise source height was conservatively taken to be 85 feet above ground. The Hybrid system was also analyzed with individual sources at both the air-cooler fans and the cooling tower cells. Additionally, the circulating cooling water pumps

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[12] The potential vendor contacted for these analyses was GEA Power Cooling Systems, Inc.

[13] Note that this value does <u>not</u> include the circulating cooling water pump trains, which are typically not part of a cooling tower scope-of-supply .

needed for the cooling towers were added, assuming a maximally-mitigated set of pump trains. Thus, for both options, the quietest equipment configurations considered to be reasonable and achievable were used for this noise impact investigation. The same basic prediction methodology as used for the AFC was employed for this investigation and the physical configuration of equipment, berm, and wall barriers was also used. The predicted noise levels at the same receptor locations as used in the October 2000 AFC were calculated and compared to the aggregate noise impacts from the AFC-proposed plant design. Thus, the changes in noise from just the use of ACC or Hybrid alternative cooling were found. The results of these calculations are summarized in Tables 1a and 1b "Alternative Cooling Noise" for the ACC option and Table 2a and 2b "Alternative Cooling Noise" for the Hybrid option. For the 'a' tables, the results are for the residential and sensitive receptor locations, while the 'b' tables summarize the noise predictions for the tourist-related receptor locations (as given in the AFC).

SUMMARY

The tables show the following general observations. For the all air-cooled condenser (ACC) alternative, the nominal increase at residential and sensitive receptors is +1 dB (compared to the AFC design). However, the change to the (LORS-critical) RV Park receptor location (and, by interpolation, the closest areas of the creek/wetlands areas) is shown as +0 dB. This is because just enough barrier shielding from the HRSG structures and/or north berm wall is still present for the elevated ACC sources to prevent an increase in aggregate RV Park receptor noise levels. However, the margin of safety in meeting the most restrictive LORS requirement (i.e. the City of Morro Bay Noise Element limits) has been reduced. At the tourist areas to the west, northwest, and southwest of the project site, the nominal increase is +2 dB. Although not as beneficial to the noise environment as the AFC-proposed plant, this result is still significantly better than the existing conditions from the current power plant at tourist-related areas. For this option, all identified receptor areas are still within compliance of the pertinent regulatory limits, but the Scott Street location has now joined the RV Park as a second critical receptor (i.e., future noise is predicted to be right at the Noise Element limit).

For the Hybrid system, the nominal increase for this cooling option at the residential and sensitive receptors is +4 to +5 dB. This is mostly due to the cooling tower water pumps, even though they are assumed to be quiet-design units. As with the ACC option, the change at the critical RV Park is shown to be +0 dB (due, again, to residual barrier attenuation effects in that direction). The general increase at residential/sensitive receptors means that two locations are now predicted to be out of compliance with the Noise Element limits – these are locations 2 (Scott Street) and 6 (First Church[14]). Furthermore, location 4 (Radcliff & Berwick) is now a critical receptor, being right at the Noise Element limit. At the tourist areas, the increase will be substantial….upwards of +10 dB at some locations. This is from the cooling water pumps and the lack of substantial barrier benefits in the direction of the tourist-related areas. For the Coleman Park location, this cooling alternative can be expected to yield noise levels that are comparable to the existing power plant environment.

[14] It should be noted that this location is no longer a functioning church and that the general surrounding area is predominantly commercial/hotel usages.

In summary, the best-case analysis for noise impacts shows a slightly-increased, but still compliant, situation for the ACC option. However, the marginal acceptability at the closest receptors to the project site has been reduced by the ACC addition. Further, this analysis uses preliminary vendor data and when further detailed design and engineering becomes available, these parameters may not be attainable. If any of the assumptions behind the best-case configuration prove later to be overly-optimistic and/or unattainable in the actual installation, then noise compliance may be compromised, with little or no mitigation recourse. For the Hybrid option, the evaluation shows noise levels that can be expected to be above the city's Noise Element limits at one or more receptor locations (and this is, again, for the assumed best-case conditions). Unlike the ACC option, however, there may be additional (potentially expensive) mitigation measures, albeit rather drastic, that could be considered during detail design to potentially reduce the noise emissions from these predominant sources.

In short, both ACC and Hybrid cooling alternatives are at best, problematic for achieving future noise compliance, when compared to the AFC-proposed project design.

Table 1a. CITY OF MORRO BAY NOISE ELEMENT CRITERION ANALYSIS (ACC Option)

(Limit = Nighttime Hourly L_{eq} of 45 dBA [total noise exposure at receiving land use property line])

[**bold** entries denote changes and *italicized* entries are taken from AFC Table 6.12-13 on page 6.12-49]

Location	*Description*	*Predicted MBPP Noise Contributions (AFC Noise Control Case 4),* dBA	*Total Future Noise Environment (AFC Plant Plus Nighttime Ambient),* dBA	*Difference Between Future Noise Environment And MB Noise Element Limit, dB*	Predicted MBPP Noise Contributions With Air-Cooled Condenser Alternative, dBA	**Difference Due To Air-Cooled Condenser Alternative, dB**	Revised Total Future Noise Environment (AFC Plant With Air-Cooled Condenser Alternative Plus Nighttime Ambient), dBA	Difference Between Revised Future Noise Environment and MB Noise Element Limit (ACC Option), dB
1	*Scott Street*	*41*	*44*	*1 dB under limit*	42	**+1**	**45**	**at limit**
2	*Morro Bay High School*	*36*	*43*	*2 dB under limit*	36	**+0**	43	2 dB under limit
3	*Morro Bay Elementary School*	*35*	*43*	*2 dB under limit*	36	**+1**	43	2 dB under limit
4	*Radcliff & Berwick*	*37*	*43*	*2 dB under limit*	38	**+1**	43	2 dB under limit
5	*RV Park*	*43*	*45*	*at limit*	43	**+0**	45	at limit
6	*First Church*	*38*	*44*	*1 dB under limit*	39	**+1**	44	1 dB under limit
7	*Morro Bay Public Library*	*33*	*41**	*4 dB under limit**	34	**+1**	41	4 dB under limit
8	*Olive & Piney*	*31*	*37*	*8 dB under limit*	32	**+1**	37	8 dB under limit

* The values reported in the AFC (40 dBA and 5 dB under the limit) are typos; the correct numbers are 41 dBA and 4 dB under the limit.

Table 1b. COMPARISON OF EXISTING AND FUTURE NOISE LEVELS AT MORRO BAY TOURIST AREAS (ACC Option)

[**bold** entries denote changes and *italicized* entries are taken from AFC Table 6.12-14 on page 6.12-56]

Location	*Description*	*Predicted MBPP Noise Contributions (AFC Noise Control Case 4), dBA*	*Predicted Project Contribution Compared to Measured Existing Ambient*	Predicted MBPP Noise Contributions with Air-Cooled Condenser Alternative, dBA	Difference Due to Air-Cooled Condenser Alternative, dB	Revised Predicted Project Contribution (with Added Air-Cooled Condensers) Compared to Measured Existing Ambient
10	*Embarcadero(1)*	*44*	*23 dB under existing ambient*	46	**+2**	**21 under existing ambient**
11	*Coleman Park (2)*	*46*	*9 dB under existing ambient*	48	**+2**	**7 under existing ambient**
12	*Beach Shoreline (3)*	*42*	*20 dB under existing ambient*	43	**+1**	**19 under existing ambient**
13	*Morro Rock, East (4)*	*36*	*14 dB under existing ambient*	38	**+2**	**12 under existing ambient**
14	*Morro Rock, West (5)*	*<20*	*>35 dB under existing ambient*	<20	negligible	> 35 under existing ambient

1. Location at Salt Water Taffy Shop, 1247 Embarcadero, directly across street from (existing) Center Stack
2. Location at Park at corner of Embarcadero and Coleman, near park bench area, northwest of swings
3. Location at shoreline, just south of the creek outlet wash area
4. Location at bend in Morro Rock access road, at west end of parking area
5. Location at end of Morro Rock access road, northeast of breakwater

Table 2a. CITY OF MORRO BAY NOISE ELEMENT CRITERION ANALYSIS (Hybrid Option)

(Limit = Nighttime Hourly L_{eq} of 45 dBA [total noise exposure at receiving land use property line])

[**bold** entries denote changes and *italicized* entries are taken from AFC Table 6.12-13 on page 6.12-49]

Location	*Description*	*Predicted MBPP Noise Contributions (AFC Noise Control Case 4), dBA*	*Total Future Noise Environment (AFC Plant Plus Nighttime Ambient),dBA*	*Difference Between Future Noise Environment And MB Noise Element Limit, dB*	Predicted MBPP Noise Contributions With Hybrid Cooling System Alternative, dBA	Difference Due To Hybrid Cooling System Alternative, dB	Revised Total Future Noise Environment (AFC Plant with Hybrid Cooling System Alternative Plus Nighttime Ambient), dBA	Difference Between Revised Future Noise Environment And MB Noise Element Limit (Hybrid Option), dB
1	*Scott Street*	*41*	*44*	*1 dB under limit*	46	**+5**	**47**	**2 dB over limit**
2	*Morro Bay High School*	*36*	*43*	*2 dB under limit*	36	+0	43	2 dB under limit
3	*Morro Bay Elementary School*	*35*	*43*	*2 dB under limit*	39	**+4**	**44**	**1 dB under limit**
4	*Radcliff & Berwick*	*37*	*43*	*2 dB under limit*	42	**+5**	**45**	**at limit**
5	*RV Park*	*43*	*45*	*at limit*	43	+0	45	at limit
6	*First Church*	*38*	*44*	*1 dB under limit*	42	**+4**	**46**	**1 dB over limit**
7	*Morro Bay Public Library*	*33*	*41**	*4 dB under limit**	37	**+4**	**42**	**3 dB under limit**
8	*Olive & Piney*	*31*	*37*	*8 dB under limit*	35	**+4**	**39**	**6 dB under limit**

* The values reported in the AFC (40 dBA and 5 dB under the limit) are typos; the correct numbers are 41 dBA and 4 dB under the limit.

Table 2b. COMPARISON OF EXISTING AND FUTURE NOISE LEVELS AT MORRO BAY TOURIST AREAS (Hybrid Option)

[**bold** entries denote changes and *italicized* entries are taken from AFC Table 6.12-14 on page 6.12-56]

Location	*Description*	*Predicted MBPP Noise Contributions (AFC Noise Control Case 4), dBA*	*Predicted Project Contribution Compared to Measured Existing Ambient*	Predicted MBPP Noise Contributions with Hybrid Cooling System Alternative, dBA	Difference Due to Hybrid Cooling System Alternative, dB	Revised Predicted Project Contribution (with Added Hybrid Cooling System) Compared to Measured Existing Ambient
10	*Embarcadero (1)*	*44*	*23 dB under existing ambient*	**54**	**+10**	**13 under existing ambient**
11	*Coleman Park (2)*	*46*	*9 dB under existing ambient*	**55**	**+9**	**Same as existing ambient**
12	*Beach Shoreline (3)*	*42*	*20 dB under existing ambient*	**43**	**+1**	**19 under existing ambient**
13	*Morro Rock, East (4)*	*36*	*14 dB under existing ambient*	**43**	**+7**	**7 under existing ambient**
14	*Morro Rock, West (5)*	*<20*	*>35 dB under existing ambient*	<20	negligible	> 35 under existing ambient

1. Location at Salt Water Taffy Shop, 1247 Embarcadero, directly across street from (existing) Center Stack
2. Location at Park at corner of Embarcadero and Coleman, near park bench area, northwest of swings
3. Location at shoreline, just south of the creek outlet wash area
4. Location at bend in Morro Rock access road, at west end of parking area

Appendix H --Air Impacts

MBPP has evaluated the air quality impacts of two alternative cooling methods for the proposed turbine project: 100% dry cooling using air-cooled condensers (ACCs) and a hybrid cooling system that includes ACCs and cooling towers. Using building dimensions and cooling tower parameters provided by DFD, worst-case turbine operations were reevaluated using the same operating assumptions that were used in the AFC. The modeling analysis showed that because of the distance between the stacks and the new cooling structures, the 100% dry cooling alternative had no effect on maximum modeled impacts. The addition of cooling towers in the hybrid system resulted in increases in ambient PM_{10} impacts over the proposed project and the ACC cooling alternative. Overall, there were no significant changes to the modeled impacts from these alternative cooling methods.

The modeling results for the alternative cooling methods are summarized, along with the results for the project as proposed, in the following tables.

Table 1: Project Alone (modeled concentrations in ug/m^3)

Cooling Alternative	Pollutant/Averaging Period									
	NO_2		SO_2				CO		PM_{10}	
	1-hr	Annual	1-hr	3-hr	24-hr	Annual	1-hr	8-hr	24-hr	Annual
Project As Proposed	220	2.9	17.3	10.4	2.7	0.23	326.3	1,508	24.2	2.7
Project with 100% Dry Cooling	220	2.9	17.3	10.4	2.7	0.23	326.3	1,508	24.2	2.7
Project with Hybrid Cooling System	220	2.9	17.3	10.4	2.7	0.23	326.3	1,508	26.2	3.0

Table 2: Project plus Background (modeled concentrations in ug/m^3)

	Pollutant/Averaging Period									
	NO_2		SO_2			CO		PM_{10}		
	1-hr	Annual	1-hr	24-hr	Annual	1-hr	8-hr	24-hr	AAM[2]	AGM[3]
Maximum Monitored Ambient Concentrations[1]	122	25	106	13	0	6,988	3,444	57	20.6	18.6
Project As Proposed	342.4	27.9	123	15.7	0.23	7,314	4,952	81.2	23.3	21.3
Project with 100% Dry Cooling	342.4	27.9	123	15.7	0.23	7,314	4,952	81.2	23.3	21.3
Project with Hybrid Cooling System	342.4	27.9	123	15.7	0.23	7,314	4,952	83.2	23.6	21.6
State Standard	470	--	650	109	--	23,000	10,000	50	--	30
Federal Standard	--	100	--	365	80	40,000	10,000	150	50	--

Appendix I – Land Use Impacts

This section provides an analysis of the conformity of placing a power plant facility that uses dry cooling or a hybrid cooling system on the MBPP project site with the City of Morro Bay Land Use planning documents. In summary, installing dry cooling at the MBPP site will conflict with multiple areas of the Land Use Planning documents. The attached table (see Table 1, below) provides the exact text of the policies that dry cooling conflicts with and reasons why the conflict occurs. The conflicts are briefly summarized below.

SIGNIFICANT NEGATIVE VISUAL IMPACTS

There are multiple policies in the CLUP, and General Plan that call for protecting and improving the visual corridors in Morro Bay (see attached Table 1). For example, LCP Policy 5.01 states: "....Power plant expansion on PG&E owned property shall have priority over other coastal dependent industrial uses. Power plant expansion shall be limited to small facilities whose location would not further effect the views of Morro Rock from State Highway One and high use visitor-serving areas, consistent with Policy 12.11."

Placing dry cooling towers on the MBPP site is not consistent with this and several other local visual policies (see the visual analysis and KOPs for more specific information on the detrimental visual impacts).

PROPERTY OWNERSHIP

The large cooling towers do not fit in the current MBPP site. To accommodate the large dry cooling towers in an appropriate location, a portion of the towers would have to be built on PG&E property (see DFD plot plan). Duke Energy does not currently own this property and it is highly questionable if Duke would be able to lease or purchase additional property from PG&E that is currently being used for their switchyard.

Table 1: LAND USE PLANS AND POLICIES THAT CONFLICT WITH DRY COOLING AT MORRO BAY POWER PLANT

Policy #	POLICY TEXT	WHY DRY COOLING IS NOT CONSISTENT WITH PROGRAM, POLICY, OR REGULATION
CITY OF MORRO BAY - GENERAL PLAN II. Land Use, Open Space, and Conservation Elements		
Sensitive Lands and Open Space		
GP Program LU-62.1	All developments at or adjacent to the harbor or beach areas shall provide for physical and visual public access to these features.	The additional dry cooling towers would have significant negative impacts on the views of Morro Rock and from visitor serving areas in Morro Bay
CITY OF MORRO BAY – COASTAL LAND USE PLAN (LUP)		
Chapter VII. Energy/Industrial Development		
LCP text	According to a CEC report entitled "Feasibility of Expansion of Existing Coastal Zone Power Plants," the power plant site is the minimal adequate for expansion of small facilities whose location would not further affect the unique view corridor of Morro Rock and the report indicates that conversion is unfeasible due to a variety of factors. The study does conclude that expansion is feasible for a small-scale facility utilizing either steam turbine, the existing generating system, combined cycle, or combustion. (LUP, p. 107 & 109)	The additional dry cooling towers would have significant negative impacts on the views of Morro Rock and from visitor serving areas in Morro Bay.
F. Policies on Energy Related Development		
General Policies		
LCP Policy 5.01	… Power plant expansion on PG&E owned property shall have priority over other coastal dependent industrial uses. Power plant expansion shall be limited to small facilities whose location would not further effect the views of Morro Rock from State Highway One and high use visitor-serving areas, consistent with Policy 12.11. (General Plan policy # LU-39.1)	The additional cooling towers would create significant adverse impacts on the view of Morro Rock and from visitor serving areas in Morro Bay.
LCP Policy 5.21	Substantial landscaping and screening to mitigate the visual impacts of existing and future facilities; with particular emphasis on screening the facilities located between the power plant and Highway One. (General Plan policy # LU-40.16)	The additional cooling towers would create significant adverse impacts on the view of Morro Rock and from visitor serving areas in Morro Bay.
Chapter XIII Visual Resources		

Policy #	POLICY TEXT	WHY DRY COOLING IS NOT CONSISTENT WITH PROGRAM, POLICY, OR REGULATION
E. Visual Resources Policies		
LCP Policy 12.01	The scenic and visual qualities of coastal areas shall be considered and protected as a resource of public importance. Permitted development shall be sited and designed to protect views to and along the ocean and scenic and coastal areas, to minimize the alteration of natural land forms, to be visually compatible with the character of surrounding areas, and where feasible, to restore and enhance visual quality in visually degraded areas. New development in highly scenic area such as those designated on Figure 31, shall be subordinate to the character of its setting.	MBPP is designated on Figure 31 as an area of visual significance. . The additional cooling towers would create significant adverse impacts on the view of Morro Rock and from visitor serving areas in Morro Bay.
LCP Policy 12.02	Permitted development shall be sited and designed to protect views to and along the coast and designated scenic areas and shall be visually compatible with the surrounding areas. Specific design criteria shall be established for the following areas: The Embarcadero (as defined in Policy 2.03) Downtown commercial area. The criteria shall include the following specific requirements and shall be applied to proposed projects on a case-by case basis during architectural review: Building height/bulk relationship compatible with existing surrounding uses; landscaping to restore and enhance visually degraded areas using native and drought resistant plant and tree species; Preservation and enhancement of views of the ocean, bay, sandspit and Morro Rock; Any other requirements applicable from Coastal Commission conceptual approval of the Urban Waterfront Restoration Plan.	The additional cooling towers would create significant adverse impacts on the view of Morro Rock and from visitor serving areas in Morro Bay.
LCP Policy 12.06	New development in areas designated on Figure 31 as having visual significance shall include as appropriate the following: Height/bulk relationships compatible with the character of surrounding areas or compatible with neighborhoods or special communities which, because of their unique characteristics, are popular visit destination points for recreation uses. Designation of land for parks and open space in new developments which because of their location are popular visitor destination points for recreation uses. View easements or corridors designed to protect views to and along the ocean and scenic and coastal areas.	MBPP is identified on figure 31. The additional cooling towers would create significant adverse impacts on the view of Morro Rock and from visitor serving areas in Morro Bay. The cooling towers will introduce two large bulky obstacles to the coastal viewer and degrade view corridors.

Policy #	POLICY TEXT	WHY DRY COOLING IS NOT CONSISTENT WITH PROGRAM, POLICY, OR REGULATION
LCP Policy 12.11	Industrial development shall be sited and designed in areas specifically designated in the Land Use Plan to protect views to and along the ocean and scenic coastal areas, to minimize land alteration, to be visually compatible with the character of the surrounding areas, and where feasible, shall include measures to restore and enhance visually degraded areas. In addition, industrial development shall be subordinate to the character of its setting.	The additional cooling towers would create significant adverse impacts on the view of Morro Rock and from visitor serving areas in Morro Bay.
CITY OF MORRO BAY ZONING ORDINANCE (Municipal Code Section 17) (MC)		
Coastal Dependent Industrial (M2) District		
MC 17.24.150	Thermal power plant and support facilities which must be located on or adjacent to the sea in order to function (may be allowed with the appropriate permits and licenses). Conditional Use Permit is Required. Thirty foot building height limit. (For new construction only. Does not apply to replacement or repair of existing structures).	While the modernization and replacement project, as originally proposed in the AFC, complies with the height requirement, compliance of an air-cooled or hybrid system could be challenged as the additional structures could be considered a new facility and there fore a non conforming use due to the height limit.

Appendix J -- Terrestrial Biology Impacts

The Huffman Broadway Group, Inc. (HBG) has evaluated the terrestrial biology impacts of the two alternative cooling methods for the Morro Bay Power Plant (MBPP) Modernization Project. The two alternatives are 100% dry cooling using air-cooled condensers (ACCs) and a hybrid cooling system that includes ACCs and cooling towers. Plot plans provided by DFD indicate that although the addition of the ACCs and ACCs and cooling towers, respectively, in the two alternatives, results in larger facility footprints when compared to the currently proposed project, these additional facilities are sited on industrialized areas that are currently utilized by the MBPP or are on PG&E property (PG&E switchyard). Both of these areas have minimal habitat value. Based on the plot plans, neither of these alternatives results in substantially different terrestrial habitat impacts as a result of the increased footprint when compared to the proposed project. If it became necessary to shift the cooling facilities to the west, to remove them from property not owned by Duke Energy, there are constraints to the west of the tank farm related to the coastal dune scrub Environmentally Sensitive Habitat Area (ESHA).

Air quality analyses of the two alternatives, conducted by Sierra Research, indicate that overall, there were no significant changes to the modeled pollutant values related to these alternatives when compared to the proposed project. Therefore, no significant adverse impacts to terrestrial biological resources related to air quality are expected as a result of either of these alternatives.

Noise analyses were conducted by Alliance Acoustical Consultants, Inc., utilizing engineering data from the manufacturer of the systems, and utilizing “best-case” values. These analyses indicated that neither alternative results in an increase in noise at Morro Creek, an ESHA. This is due to the potential shielding by either the heat recovery steam generation system (HRSG) and/or the northern berm and the proposed sound wall. According to the calculations, these features keep the additional cooling system noise contribution from both of the dry cooling alternatives from increasing the total plant noise at Morro Creek.

In general, predicted increases in decibel levels at receptor locations to the west, northwest and southwest related to the 100% ACC alternative are not significant. Both Coleman Park (which is adjacent to the coastal dune scrub ESHA) and the eastern side of Morro Rock experience increases in noise of 2 dB under the 100% ACC alternative. This results in noise measurements that are still significantly better than the existing conditions from the current power plant.

Predicted increases in decibel levels at receptor locations to the west, northwest and southwest related to the hybrid alternative would be greater than those calculated for the 100% ACC alternative. For example, noise levels predicted for the eastern side of Morro Rock could be expected to increase by 7 dB compared to the noise levels of the proposed project, resulting in a plant contribution of 43 dBA. Neither noise levels from the proposed project nor increases related to the hybrid cooling alternative would be expected to interfere with breeding behavior of peregrine falcons at Morro Rock since both the proposed project and the hybrid cooling alternative noise levels are below the existing ambient noise level at Morro Rock. Analyses indicated an increase of 9 dB (from 46 dBA to 55 dBA) at the Coleman Park location, which is adjacent to dune scrub ESHA. This noise level is comparable to the existing ambient noise level.

In summary, no significant adverse impacts to terrestrial biological resources are expected as a result of predicted noise levels of either the 100% ACC cooling alternative or the hybrid alternative.

Appendix K – Previous Duty Cycle (June 2001)

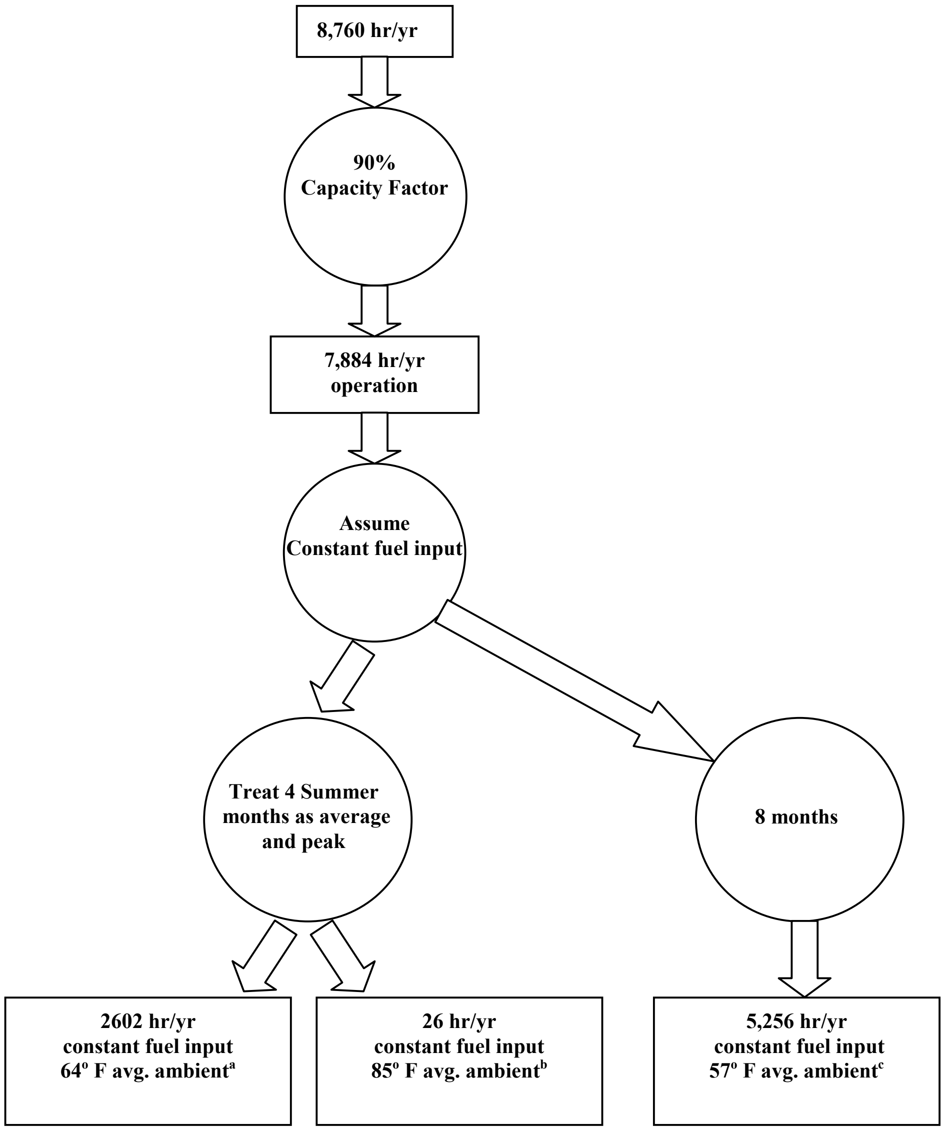
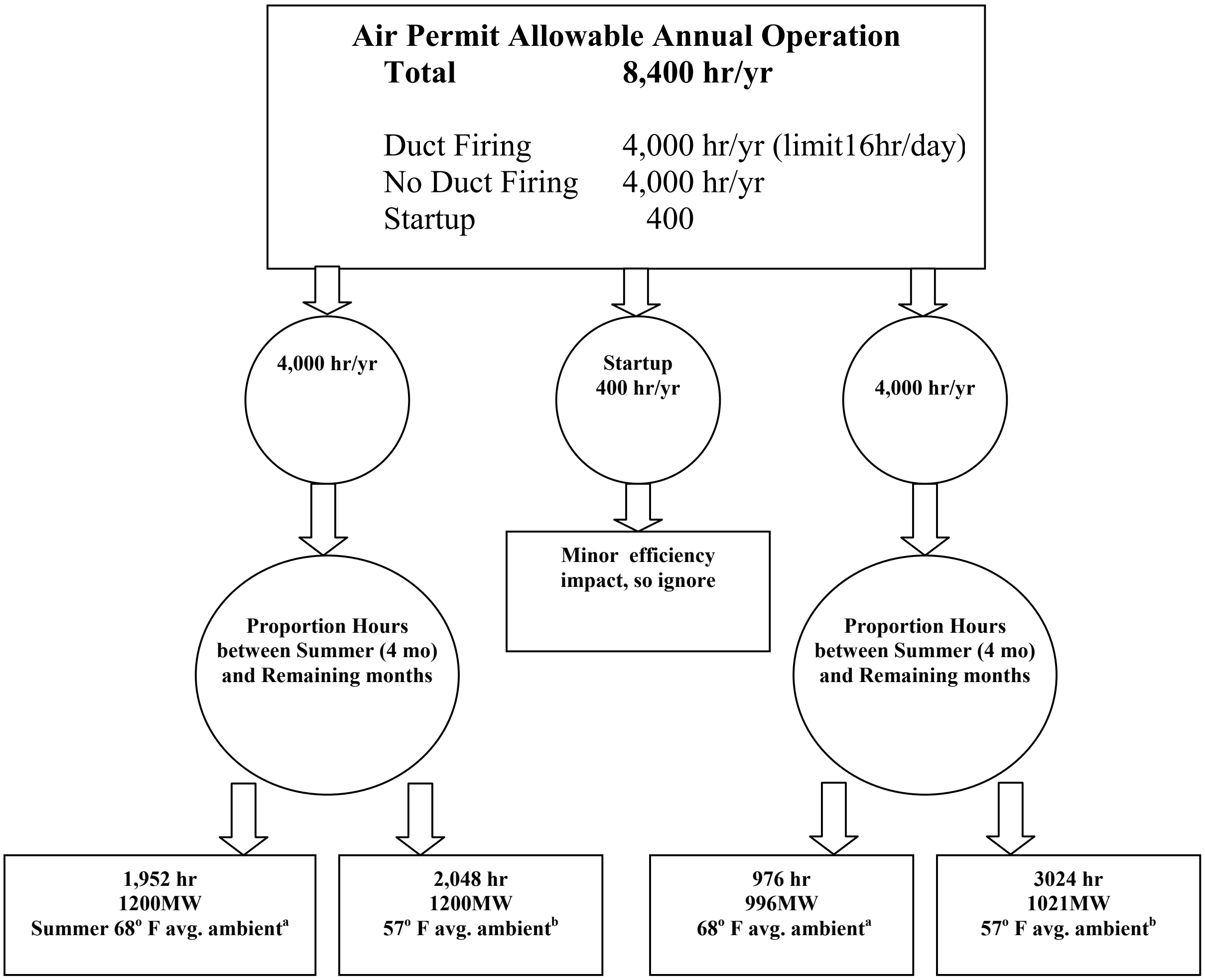


Figure notes:

a. Mean maximum annual temperature
b. Highest expected temperature
c. Mean average annual temperature

Temp Data:
International Station Meteorological Climate Summary, Version 4.0 1996
Issued by: Federal Climate Complex, Asheville, NC
Monterey Peninsula (WMO No. 724915)
Period of Record 1973 to 1996

Appendix L – Current Duty Cycle (January 2002)



Notes:

a. Mean historical maximum temperature during Jun-Sep
b. Mean historical average annual temperature

Temp data source:
International Station Meteorological Climate Summary, Version 4.0 1996
Issued by: Federal Climate Complex, Asheville, NC
Monterey Peninsula (WMO No. 724915)

Appendix M– Current Alternative Cooling Fuel Usage Results

The plant fuel usage results below were developed using the Thermoflow (V10.2) suite of combined cycle power plant thermal modeling software, namely GTPro and GTMaster. A review of the results below, specifically for the 57 degree case, would indicate a slight efficiency advantage of once through cooling over ACC or hybrid systems.

However, the efficiency advantage of once-through cooling becomes more pronounced at higher ambient temperatures, and is most prominent with duct firing. For example, the absolute difference in peak-load heat rate between a once-through and alternatively cooled plant nearly triples when the ambient temperature increases from 57°F to 68°F (rising from 83Btu/kWh to 203 Btu/kWh). This means that the efficiency advantage of once-through cooling over alternative cooling would be nearly 2.5 times greater at 68°F than 57°F.

Table 1: Current Performance Results

Once-through Cooling

Ambient Temperature: / Relative Humidity:	**57°F 73%**		**68°F 68%**	
PARAMETER	**1021MW**	**1200MW**	**996MW**	**1200MW**
CTG Operating	2	2	2	2
CTG Load (%)	100	100	100	100
Duct Burner Fuel Input (MMBtu/hr) HHV	0	1559	0	1779
Plant Fuel Input (MMBtu/hr) HHV	7096	8653	6905	8684
Gross Plant Output (MW)	1056	1239	1030	1239
Net Plant Output (MW)	1021	1200	996	1200
Net Plant Heat Rate (Btu/kW-hr) HHV	6949	7211	6935	7237

CONSTANT NET OUTPUT

Air Cooled Condenser

Ambient Temperature: / Relative Humidity:	**57°F 73%**		**68°F 68%**	
PARAMETER	**1021MW[a]**	**1200MW**	**996MW[a]**	**1200MW**
CTG Operating	2	2	2	2
CTG Load (%)	100	100	100	100
Duct Burner Fuel Input (MMBtu/hr) HHV	41.9	1658	105	2024
Plant Fuel Input (MMBtu/hr) HHV	7136	8753	7010	8928
Gross Plant Output (MW)	1051	1238	1028	1239
Net Plant Output (MW)	1021	1200	996	1200
Net Plant Heat Rate (Btu/kW-hr) HHV	6989	7294	7041	7440

CONSTANT NET OUTPUT

Hybrid Wet/Dry Cooling

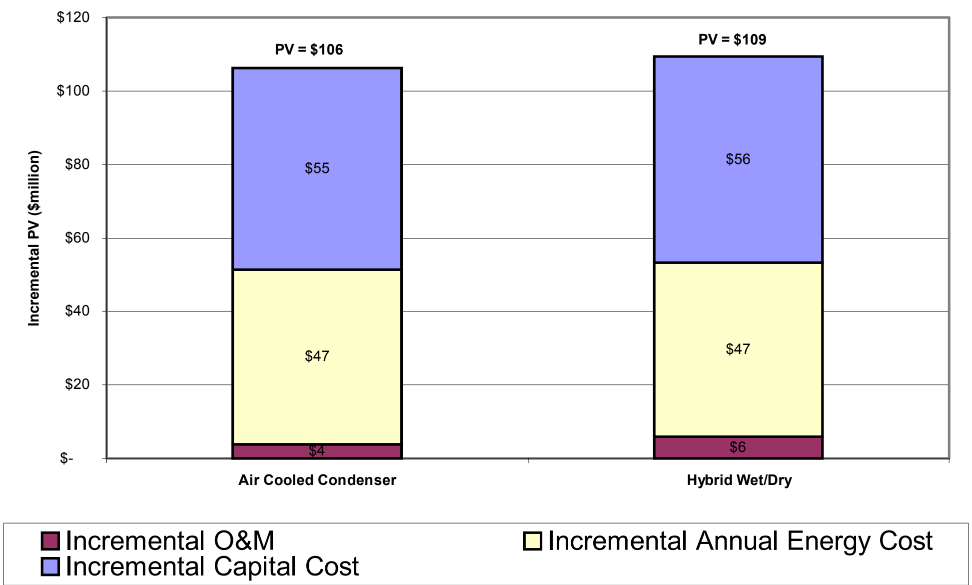
Ambient Temperature: / Relative Humidity:	**57°F 73%**		**68°F 68%**	
PARAMETER	**1021MW[a]**	**1200MW**	**996MW[a]**	**1200MW**
CTG Operating	2	2	2	2
CTG Load (%)	100	100	100	100
Duct Burner Fuel Input (MMBtu/hr) HHV	41.9	1658	105	2024
Plant Fuel Input (MMBtu/hr) HHV	7136	8753	7010	8928
Gross Plant Output (MW)	1051	1238	1028	1239
Net Plant Output (MW)	1021	1200	996	1200
Net Plant Heat Rate (Btu/kW-hr) HHV	6989	7294	7041	7440

a. For alternatives to achieve net output equal to once-through case requires partial duct firing.

Appendix N- Current Economic Results Discussion

One impact not reflected in the current analysis is Duke's increased risk exposure to fuel price volatility if alternative cooling is required. Figure 1 shows the composition of the incremental PV for the current analysis.

Figure 1: Incremental PV Composition



Nearly half of the incremental PV reflects the incremental annual energy expenditure required to run a less efficient plant as a result of alternative cooling. The efficiency impact of alternative cooling amplifies any volatility in fuel prices. The annual energy expenditure is influenced by the price of fuel and the incremental fuel consumed. Table 1 shows the annual incremental energy cost for a normal range of likely fuel prices[15]. The mean gas price is used in the current analysis.

[15] Based on historical prices, PG&E CG forward prices published on November 30, 2001, Duke's view of forward prices and transport charges. Price statistics are per MMBtu delivered to burner tip covering Jan 2002 through Dec 2010.

Table 1: Estimated Incremental Annual Energy Cost

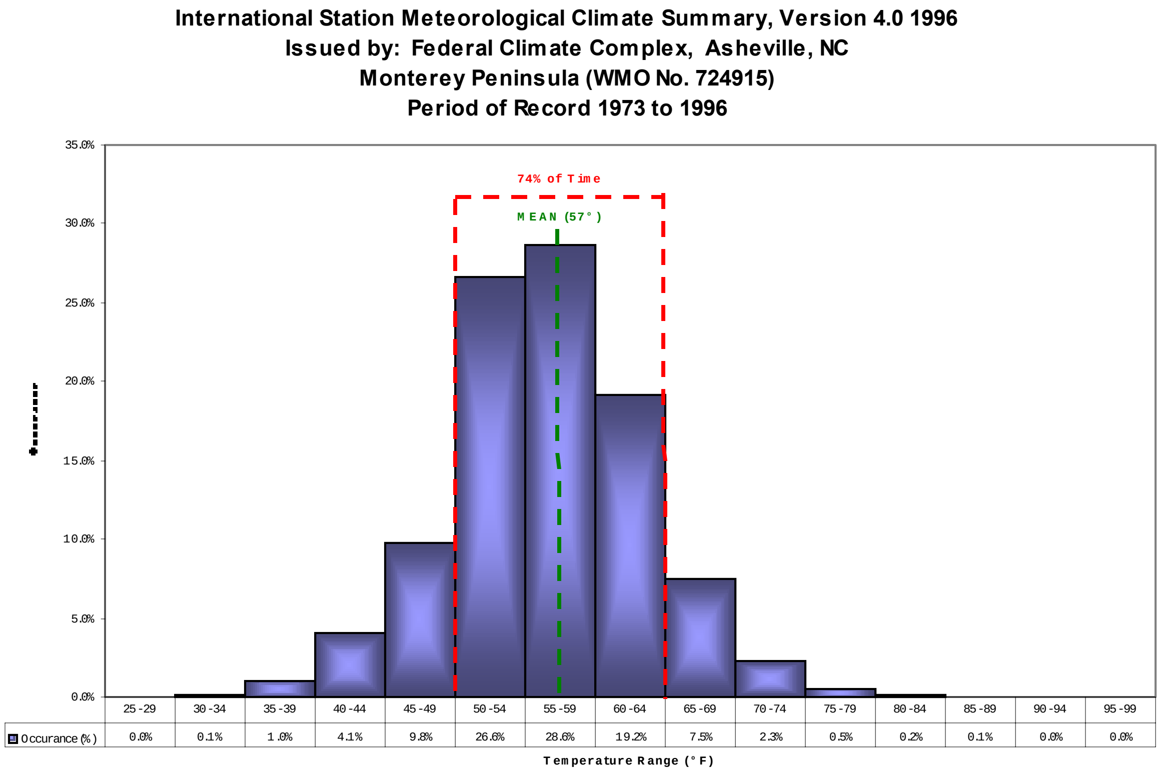
	Low	Mean	High
Gas Price ($/MMBtu):	$3.0	$4.2	$4.89
Air Cooled Condenser ($mil)	$2.8	$3.8	$4.4
Hybrid Wet/Dry Cooling ($mil)	$2.8	$3.8	$4.4

The annual energy cost changes in direct proportion to changes in fuel price. If fuel price volatility returns to what was experienced in California last year, not unlikely in light of increasing gas demand and uncertain reserves, The impact on the incremental PV would be significant. If mean gas prices were to double to $8.46/MMBtu[16], the annual energy cost would double and the incremental PV of alternative cooling would increase by nearly 50%. Duke's increased risk exposure to fuel price volatility has not been accounted for in the current analysis.

The incremental gas consumed is a reflection of the duty cycle. The duty cycle defines the annual hours of operation, the net output and the ambient temperatures. In keeping with the level of the overall evaluation and Duke's standard methodology for evaluating project investment decisions, only two temperature points were used representing the warmer summer months and the remainder of the year. As can be seen in Figure 2 the ambient temperature on average remains within a limited range over the course of a year. For this reason, expanding the duty cycle to additional temperature points would not likely provide additional resolution. The hours of operation are the maximum allowed by the air permit. The actual hours may vary, but using the permitted values keeps the analysis consistent with the AFC.

[16] Conservative considering gas prices in California reached $13/MMBtu in 2001

Figure 2: Temperature Distribution for Average Year

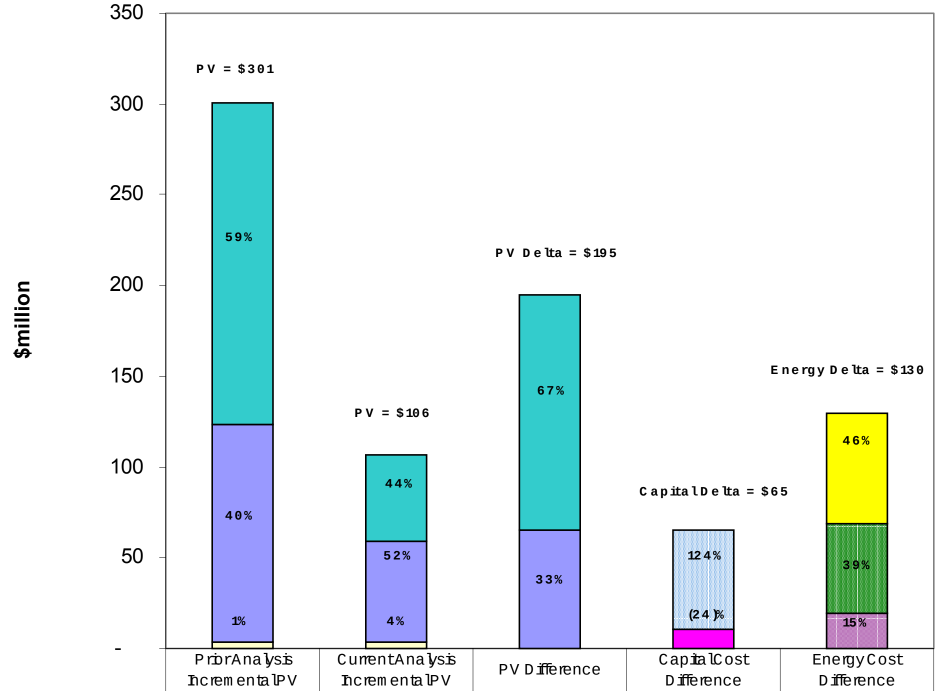


Figures 3 and 4 compare the compositions of the Present Value (PV) results from the current and previous analysis. The first bar to the left shows the incremental PV from the previous analysis. The next bar to the right is the current PV. The difference in PV, next bar, can be attributed to changes in capital costs and annual energy costs.

The next bar to the right shows that the capital cost difference consists of two components. First, the current analysis reflects the increased capital cost required to achieve 1200MW nominal output over the temperature range and through a more detailed assessment. Additionally, a noise mitigation package would be required to attempt to comply with City noise requirements. The remainder is due to the change in valuation methodology which eliminated the proxy plant capital cost.

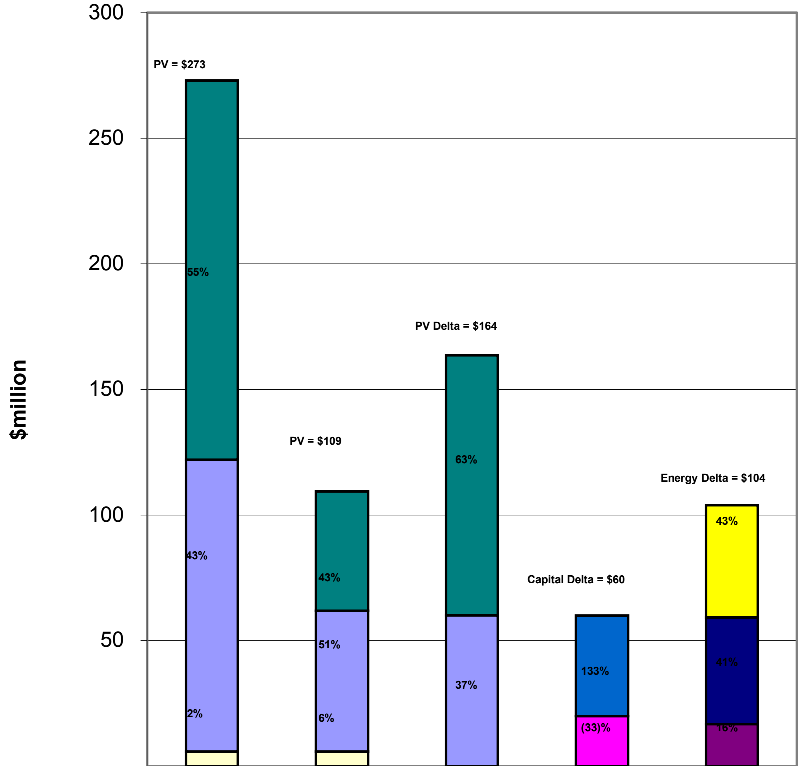
The last bar shows the three components that comprise the energy cost difference. First, the current analysis uses a $4.23/MMBtu fuel price compared to $5/MMBtu in the previous analysis. Next, the additional fuel required to make up efficiency losses is consumed in a lower heat rate plant (i.e. more efficient), resulting in reduced fuel usage. The remainder in energy cost difference is due to changes in the duty cycle and valuation methodology.

Figure 3: Air Cooled Condenser Present Value Comparison



	Prior Analysis Incremental PV	Current Analysis Incremental PV	PV Difference	Capital Cost Difference	Energy Cost Difference
Change in Duty Cycle and Valuation Methodology					60
Change in Heat Rate of Plant (10,000 vs ~7,200 Btu/kWh)					50
Change in Fuel Price ($5 vs $4.21/MMBtu)					20
Incremental Annual Energy Cost					
Change in Valuation Methodology				81	
Change in Air Cooled Condenser Capital Cost				(16)	
Hypothetical "Make-up" Plant Capital Cost					
Alternative Cooling Incremental Capital Cost					
Incremental Annual Energy Cost	177	47	130		
Incremental Capital Cost	120	55	65		
Incremental O&M	4	4			

Figure 4: Hybrid Present Value Comparison



	Prior Analysis Incremental PV	Current Analysis Incremental PV	PV Difference	Capital Cost Difference	Energy Cost Difference
Change in Duty Cycle and Valuation Methodology					45
Change in Heat Rate of Plant (10,000 vs ~7,200 Btu/kWh)					42
Change in Fuel Price ($5 vs $4.21 /MMBtu)					17
Incremental Annual Energy Cost					
Change in Valuation Methodolog				80	
Change in Hybrid Wet/Dry Capital Cost				(20)	
Hypothetical "Make-up" Plant Capital Cost					
Alternative Cooling Incremental Capital Cost					
Incremental Annual Energy Cost	151	47	104		
Incremental Capital Cost	116	56	60		
Incremental O&M	6	6			